

Far-IR/submm array of multiplexed Single Photon Detectors based on the Quantum Capacitance Detector

Completed Technology Project (2017 - 2021)



Project Introduction

We will develop a 500-pixel array of quantum capacitance detectors which have 1) per-pixel noise equivalent power (NEP) below $3e-20$ W/sqrt(Hz), 2) high absorption efficiency, and 3) sufficient speed of response to count individual mid-IR through far-IR photons at rates up to 10 kHz. The full array will be read out with a single microwave circuit using a suite of probe tones interacting with resonators. The sensitivity, speed, and MUXing are the key enabling requirements for moderate-resolution ($R \sim 500$) zodi-limited spectroscopy on future cryogenic far-IR facilities such as the Origins Space Telescope (formerly Far-IR Surveyor) or a far-IR probe-class mission. The photon counting capability offers the potential for enhanced scientific performance for a) high-stability applications such as exoplanet spectroscopy and b) high-resolution direct-detection spectroscopy at the shot-noise limit. Our work builds on the success with few-pixel quantum capacitance demonstrations at 200 microns, but we require a dedicated multi-pixel readout architecture, absorber and backshort geometry adapted to shorter wavelengths (down to 30 microns with a goal of 6 for exoplanet photon counting), and demonstration of high yield ($>75\%$) with an improved tunnel junction design and fabrication approach.

Anticipated Benefits

The Astrophysics Research and Analysis program (APRA) supports suborbital and suborbital-class investigations, development of detectors and supporting technology, laboratory astrophysics, and limited ground based observing. Basic research proposals in these areas are solicited for investigations that are relevant to NASA's programs in astronomy and astrophysics, including the entire range of photons, gravitational waves, and particle astrophysics. The emphasis of this solicitation is on technologies and investigations that advance NASA astrophysics missions and goals.



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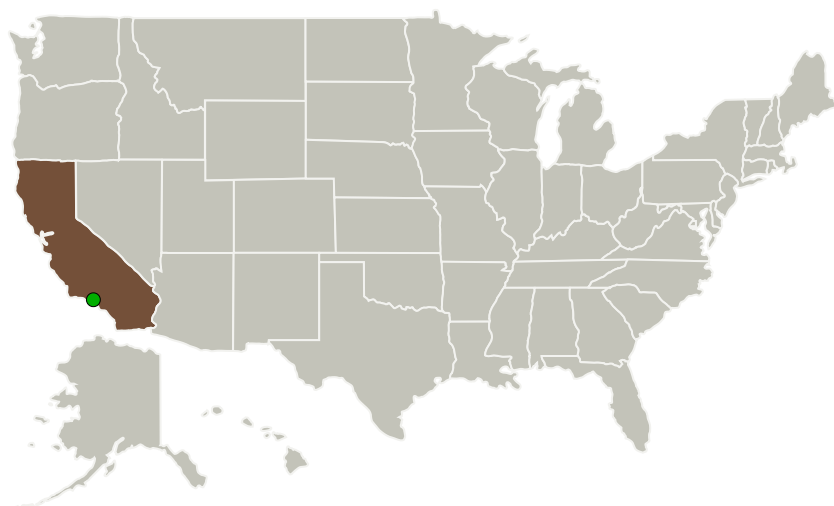
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
California Institute of Technology(CalTech)	Lead Organization	Academia	Pasadena, California
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations

California

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Organization:

California Institute of Technology (CalTech)

Responsible Program:

Astrophysics Research and Analysis

Project Management

Program Director:

Michael A Garcia

Program Manager:

Dominic J Benford

Principal Investigator:

Pierre M Echternach

Co-Investigators:Charles M Bradford
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Karen R Piggee

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Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.1 Remote Sensing Instruments/Sensors
 - └ TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System